Summary of the invention

The present invention provides a possibility to evaluate cooling curves recorded in near-eutectic cast iron melts. The curves are evaluated by determining the net amount of heat generated in the centre of the melt sample as a function of time. This information is then used to identify the part of the centrally recorded cooling curve that can be used as a basis for determining the amount of structure-modifying agent that must be added to produce compacted graphite cast iron, and/or spheroidal graphite cast iron, and to identify the part of said curve that is associated with formation of primary austenite.

Definitions

The term "cooling curve" as utilised herein refers to graphs representing temperature as a function of time, which graphs have been recorded in the manner disclosed in WO86/01755, WO92/06809.

The term "heat generation curve" as utilised herein relates to a graph showing the heat that is generated in a certain zone of a molten cast iron. For the purposes of the present invention, all heat generation curves herein are determined for a zone located in the centre of a sample of molten cast iron. This zone is generally referred to as the "A zone".

The term "sample vessel" as disclosed herein, refers to a small sample container which, when used for thermal analysis, is filled with a sample of molten metal. The temperature is then recorded during solidification in a suitable way. preferably the sample vessel is designed in the manner disclosed in WO86/01755, WO92/06809, WO91/13176 (incorporated by reference) and WO96/23206 (incorporated by reference).

The term "sampling device" as disclosed herein, refers to a device comprising a sample vessel equipped with at least two temperature responsive means for thermal analysis, said means being intended to be immersed in the solidifying metal sample during analysis, and a means for filling the sample with molten metal. The sample vessel is preferably equipped with said sensors in the manner disclosed in WO96/23206.

The term "structure-modifying agent" as disclosed herein, relates to compounds affecting the morphology of graphite present in the molten cast iron. Suitable compounds can be chosen from the group of magnesium and rare earth metals such as cerium, or mixtures of these compounds. The relationship between the concentration of structure-modifying agents in molten cast irons and the graphite morphology of solidified cast irons have already been discussed in the above cited documents WO92/06809 and WO86/01755.

The term "CGI" as utilised herein refers to compacted graphite cast iron.

The term "SGI" as utilised herein refers to spheroidal graphite cast iron.

Figures

The invention is described with reference to the accompanying figures, in which:

Figs. 1A-4A disclose cooling curves. A continuos line relates to the temperature in the centre of the melt and a dashed line relates to the temperature close to the wall of the sample vessel. Figs. 1B-4B show A zone heat generation curves corresponding to the cooling curves in figs. 1A-4A. Fig. 1 relates to normal hypo-eutectic cast iron and figs 2-3 show curves for near-eutectic cast irons comprising increased values of the carbon equivalent. Fig. 4 discloses curves relating to hypo-eutectic cast iron.

Fig. 5 is a schematic presentation of an apparatus for controlling production of compacted graphite or spheroidal graphite cast iron according to the present invention.

Fig. 6 is a schematic representation of a sample vessel in which the heat is approximately uniformly transported in all directions. During measurements the vessel is filled with molten cast iron. This molten cast iron can be considered as a freezing sphere. The A zone relates to a sphere in the centre of the molten sample and the B zone relates to the molten iron surrounding the A zone. The radii r_1 and r_2 relate to the mean radii of the A zone and the B zone, respectively.

Detailed description of the invention

As already mentioned above, the present invention relates to an improved method for interpreting cooling curves in near-eutectic cast iron melts. One of the important aspects of a cooling curve is the maximum slope of the recalescence peak of the centrally recorded cooling curve. This point is referred to as α in figures 1A, 2A and 3A. In cooling curves corresponding to near-eutectic cast iron melts, the inflexion point (referred to in the figures as "t_p") is located much closer to α and it can be very difficult to determine the slope correctly. Examples of such curves can be found in figure 2A and 3A. However, it has now turned out that the determination of the maximum slope at α can be considerably simplified if a heat generation curve corresponding to the central zone (the A zone) of the molten cast iron is calculated. Such a heat generation curve renders it possible to determine the location of t_p in the centrally recorded cooling curve and to check whether it affects the slope of the recalescence peak or not.

The thermal balance of any uniform element can be described by the relation: